

## Light:

- All segments of the electromagnetic spectrum travel with the same velocity through a vacuum.

$$c = \text{speed of light} = 3 \times 10^8 \text{ m/s}$$

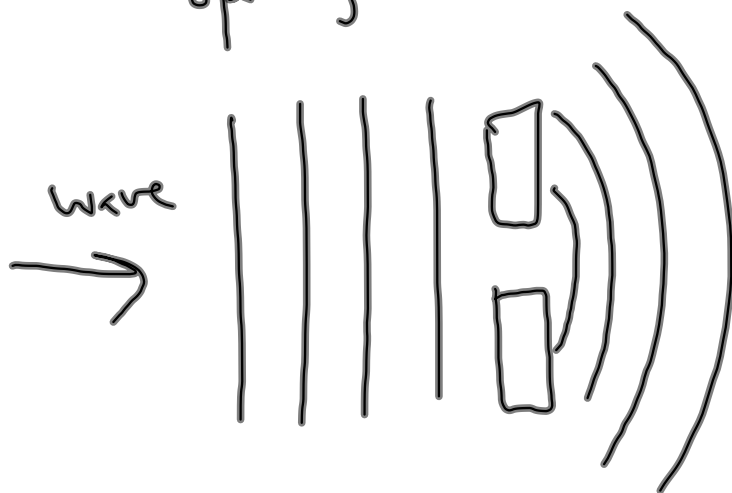
- Energy of light is related to its frequency:

$$E = hf$$
$$= \frac{hc}{\lambda}$$

$h$  is called Planck's constant

$$h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$$

- Wave/particle duality:
  - We have done experiments to show that light behaves both as a wave and as a particle.
  - Light as a wave → double-slit experiment showed constructive and destructive interference pattern
  - Diffraction is the spreading of a wave after it goes through an opening.



- Light as a particle → discovered through photoelectric effect experiment.
  - Particles are called photons.
  - Photons do not have mass, but they do have momentum and energy.
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• When light hits something, three things can happen:

- Absorption
  - Transmission
  - Reflection
- } in reality, all three happen in most processes

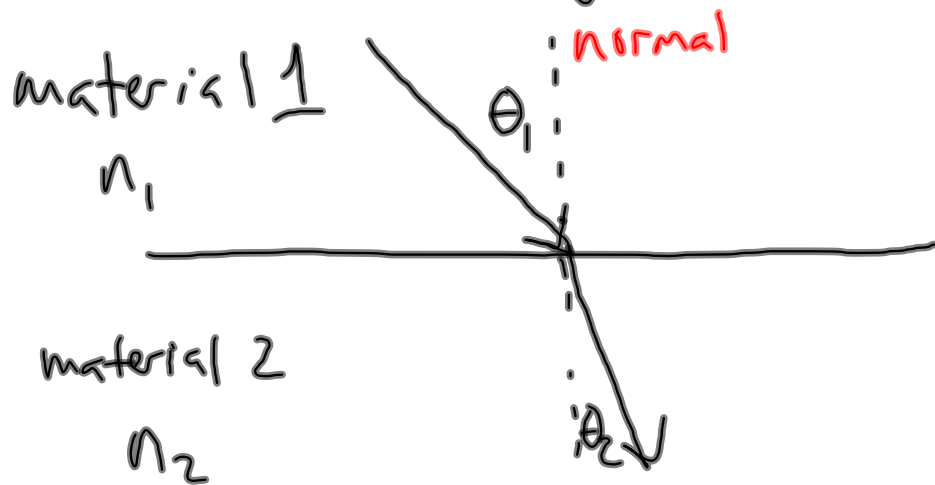
• Transmission:

- Light going through something
- Light goes slower in the medium, depending on the index of refraction of the material.

$n$  = index of refraction

$$n = \frac{c}{v} \quad \begin{array}{l} \rightarrow \text{speed of light in vacuum} \\ \rightarrow \text{speed of light in medium} \end{array}$$

- When light enters a material at some angle, it leaves the boundary at a different angle.



- Snell's law:  $n_1 \sin \theta_1 = n_2 \sin \theta_2$
- Changing the angle is called refraction.